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Detection of Implanted Devices In Underground By Using UWB Penetrating Radar with Support of PN Code

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ABSTRACT: Ground Penetrating Radar (GPR) is a method for estimation of underground structures by sending and receiving electromagnetic. With Ultra Wideband (UWB) signal, GPR is expected to improve resolution for detection of objects in underground. But there are problems that attenuation of waves from deep objects and confusion of waves from different objects. We propose a signal processing for UWB GPR to improve de-tection accuracy by applying interference cancellation technique for wireless communication. To obtain gains, we use a long transmitting signal with PN codes remain in low instantaneous power. Then estimating and cancelling reflect waves from received signals, we detect objects recursively. Position estimation of medical implanted devices can be also improved by using the technique. With comparing GPR and medical devices, we study a signal processing for position estimation for objects in dielectric substances.

KEY WORDS: GPR, UWB, PN CODES

I. INTRODUCTION

Medical implant devices, such as capsule endoscopes and micro or Nano scale implant robots, have been studied and developed to improve healthcare systems. Especially micro or Nano scale implant robots are expected to work for hyperthermia, drug delivery system, remote treatment system and others. In the field, it is very important to know the position of these devices. Accuracy of position estimation can be improved by using UWB (Ultra Wideband-) signal, which has high resolution. But some positioning errors are occurred because of attenuation and reflection by the complex structure of human body.

On the other hand, recently GPR (Ground Penetrating Radar) has been put into practical use as a nondestructive method for estimating underground structures and buried objects' positions. GPR is used for acquisition of prior information on underground construction in an urban area, ruins research, landmine detection and others. GPR sends electro- magnetic waves and observes reflection waves, and electro- magnetic waves reflect at boundaries of electrical properties such as permittivity. GPR finds and processes such reflection signals to detect objects in underground.

In GPR detection, there are two problems. One is a resolution problem. In situations such as there is shallow object or are some objects in close area, reflect waves from the objects or ground surface are hardly distinguishable from each other. UWB signal is expected to resolve this problem. Another is an attenuation problem. In situation such as there is a deep varied object, a reflect wave from the object is hardly observed because the wave's amplitude is very smaller than other waves' one from shallow objects and surface. Against the problem, we use a long transmitting signal with PN codes and obtain gains by pulse compressions. Then the small amplitude signal should be able to be detected although the instantaneous transmitting power is low. But, in this situation, large sidelobes generated by pulse compressions for a signal which has big amplitude prevent from detecting the small pulse from the deep object. So we

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apply interference cancellation technique for wireless communication to GPR. We propose a method that estimates and cancels each reflect wave recursively in order of amplitude from large to small and estimates position of each object individually.

On the issue of position estimation by signals propagating in dielectric substances, GPR and positioning estimation of implant devices have much in common. So our method for GPR is also applicable to the medical devices situations.

II. GPR POSITION ESTIMATION

In this section, we explain the way of GPR position estimation. The supposed way of measurement is scanning along ground surface in only one direction at a constant speed. Fig. 1 shows the GPR measurement process. Then position estimation of varied object is achieved by various kind of signal processing.

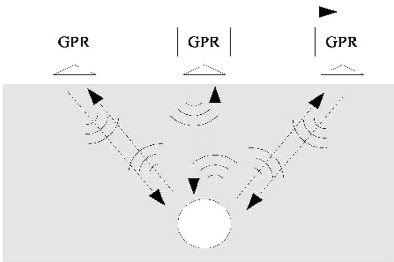

Fig.1. GPR scans underground with electromagnetic

GPR uses high-frequency (usually polarized) radio waves and transmits into the ground When the wave hits a buried objects boundary with different dielectric constants, the receiving antenna records variations in the reflected return signal. The principles involved are similar to reflection seismology, except that electromagnetic energy is used instead of acoustic energy, and reflections appear at boundaries with different dielectric constants instead of acoustic impedances.
The depth range of GPR is limited by the electrical conductivity of the ground, the transmitted center frequency and the radiated power.
GPR maps anormailtes other insight is needed for identifying pattern as tanks in these in profiles
The time that GPR measures is the round trip travel time of short nanosecond measured round tip travel time data can be converted into thickness or depth information with knowledge of the velocity of propagation in subsurface layer,as expressed in formula

D=v*t\2

Where

D=depth
V=velocity
T=two-way time

Velocity of propogation in materilas is governed by the electromagnetic properties of the materials .velocity depends primarily on the dielectric properties of the materials signal speed is slowed down by the square root of the relative dielectric constant.

V=C\√€r

Where

C=speed of light
€r=relative dielectric constant

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simulation output

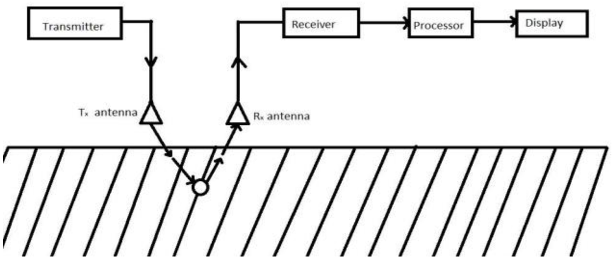

Fig2: Ground Penetrating Radar block diagram.

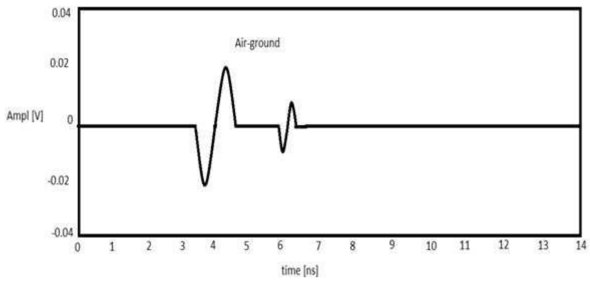

Fig3: Typical signal, received by the GPR

III. ULTRA WIDE BAND INTRODUCTION

The UWB technology is a radio modulation technique based on very short pulses transmission. These pulses have typical widths of less than 1.5 ns and thus bandwidths over 1 GHz. This technique, as defined by the Federal Communication Commission (FCC) [Fcc2002], has a Fractional Bandwidth (FB) greater than 25%.

The key value of UWB is that its RF (Radio Frequency) bandwidth is significantly wider than the information bandwidth [Fcc2000]. Moreover, thanks to advantages provided by this technology, the UWB radar presents good precision in distance calculation. Below, the principle of UWB radar and its benefits are introduced.

UWB radar sends very short electromagnetic pulses. This type of radar can employ traditional UWB waveforms such as Gaussian or monocycle pulses. To calculate the distance between radar and obstacle, the time delay Δt between emission and reception is measured. This radar offers a resolution in distance of about 15 cm for a width pulse of 1ns,so that this system is very interesting for short range road safety applications. This UWB radar presents good performances, so as firstly, the brevity of the pulses with strong spectral contents makes it possible to obtain information on the target with a rich transitory response content. This allows the dissociation of various echoes at the reception stage. Then the broad band spectrum authorizes to obtain results on the entire frequency band in a single measurement together with a strong capacity of detection. Finally the pulse spectrum has capabilities to penetrate through naturally screening materials.

IV. OUTPUT DIAGRAMS

For Stone's:

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For wet Sand:

For Sand:

V. CONCLUSION

Many factors are reported to affect the objects detection using GPR. Among those factors that we evaluated in this study are the type of object , the conditions of the host soil and dielectric constants and depth and the radar frequencies. A theoretical overview and the architecture and the individual codes and the combined effects of these factors on the dielectric constant between the layer to layer and attenuation rate of the radar waves were conducted. However , the ability of GPR to detect metallic landmines degrades slightly by increasing the water and clays contents of the host soil as this directly increases the dielectric contrast for the metallic landmine.

GPRs are mostly designed for geophysical applications and use central frequencies below 1GHZ. As landmines are small objects and are buried objects close to the air ground interface , a larger bandwidth is needed for a better depth resolution and detailed echo. For that the use of UWB GPR imposes itself. It can be expected that larger bandwidth also will enhance the classification rate of the GPR. Furthermore , the use of a large bandwidth has his implications on the hardware of the GPR system. an accurate position and good resolution of the object

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